CASE STUDY: Highways Agency - Stabilisation of A21 Embankment

SECTOR TYPE: Infrastructure – road

LOCATION: Stocks Green, Kent

CLIENT: Highways Agency

PRINCIPAL DESIGNER: Balfour Beatty, Mott MacDonald

GEO-TECHNICAL DESIGN CONSULTANT: Electrokinetic Ltd

CONTRACTORS ENVIRONMENTAL CONSULTANT: Balfour Beatty, Mott MacDonald

PRINCIPAL CONTRACTOR: Interserve

CONTRACT VALUE: £730,000

CONTRACT DURATION: 5 months

The Project

This project aimed to stabilise a failing embankment along a short stretch of the A21 known as Stocks Green. Unstable embankments are a common problem on the highway network and pose a risk to passing motorists. However, the most commonly used stabilisation methods involve considerable environmental disturbance, along with the import of large quantities of materials and exports of large quantities of waste.

To improve upon these unsustainable methods, a new stabilisation technique was implemented at the progressively failing embankment at Stocks Green, monitored by Balfour Beatty and Mott MacDonald. Using patented materials known as electrokinetic geosynthetics (EKG), the technique involved an unobtrusive method of removing water and significantly strengthening the soil using electrodes which functioned as soil nails and drains.

The Stocks Green scheme provided a permanent solution to the problem of the failing embankment. The design life of the solution is 60 years, which is comparable to other slope remediation techniques.

Compared with traditional approaches, the EKG method resulted in fewer HGV movements, zero waste removal, minimal material import, reduced noise and vibration, improved air quality, no visual impacts, no disruption to passing motorists and less damage to root protection areas. These benefits ultimately resulted in a more cost effective project.

The pioneering project received the Innovation Award at the Institution of Civil Engineers’ (ICE) regional Excellence Awards, and won the 2012 Green Apple Award in the Ground Engineering category, and was highly commended under the Highways Agency supplier recognition scheme 2012.
The Benefits

- **Reduced carbon** – comparison of this EKG approach with the conventional techniques indicated a 76% reduction in carbon footprint compared to excavate and replace, and a 40 to 50% reduction compared to soil nailing.
- **Materials** – due to the reuse of anode/cathode wiring for other schemes, the only waste generated on the Stocks Green project was a small amount of vegetation clearance for site access purposes.
- **Landscape and visual impacts** – there were seven residential properties near to the works, the closest of which was immediately adjacent to the site. Visual impacts from conventional methods of stabilising embankments are significant and, even when replanting vegetation is possible, it can take a long time for vegetation to recover and screen the A21 from the properties. The new technique used resulted in the preservation of the seed bank and soil environment, minimal vegetation clearance and no visual impacts.
- **Energy efficiency** – to ensure fuel use and noise on the Stocks Green scheme was kept to a minimum, a low noise, fuel-efficient generator was chosen. Likewise, the cathodes were inserted in the soil in an uphill position to make the best use of gravity to help water weep out of the drainage channels and keep fuel use to a minimum.
- **Local community** – reduced vehicle movements meant far less disruption in the form of noise or vibration for residents, improved safety for other road users and enhancement to local air quality.
- **Cost** – this method was more cost effective, with no waste disposal/transportation or purchase/transportation costs. Also, only a small workforce was required to operate a single lightweight slope climbing rig, reducing fuel consumption costs and associated emissions. Initial indications suggest the EKG stabilisation offers a cost saving of 30% compared to conventional methods.

The Process

The key processes underpinning the project:

- The technique used is a multifunctional approach and remediates the slope by combining improvements to a number of factors. These include improving the strength of weak soils, reducing the water pressure by drainage and transferring loads away from weaker soil by reinforcement.
- Traditionally, embankment strengthening involves clearing the slope of vegetation and requiring lanes to be closed off to the road. Heavy equipment is then used to strip and compact the soil, before nails are installed to hold the slope in place.
- EKG uses an electric current to strengthen the soil in the slopes. EKG anode nails and cathode drains were installed in the embankment, amongst the existing trees, to remove moisture from the ground and improve strength of the bulk material and bond the soil and nails.

Key Learning Points

- This technique is currently being used at a second site on the M5 in Worcestershire, using much of the same equipment.
- Although used so far on transport infrastructure, the technique will be applicable to other slopes such as flood control structures and some inland and coastal slopes.
- Highways Agency is also considering its use in road widening and improvements for managed motorways.
- There is potential for its use in Europe, US and other parts of the world with large concentrations of soft clays and silts.

End User Feedback

“Although the principles of electro-osmosis have been known for more than 200 years it has taken some time to develop a process which is suitable for our purposes, marrying the physics with modern materials and innovative design and application. This is the first time in the UK that it has been used on a major road, and I am delighted that its potential benefits have been recognised in this way.”

Jan Marsden, Geotechnical Expert, Highways Agency

“The judges look for projects which can be developed and replicated as part of an ongoing programme of environmental best practice so we were impressed to hear the technology had already been implemented elsewhere in the country – a sure testament to its success.”

Judges’ comments, ICE South East England Engineering Excellence Awards, June 2012

Learn more

http://www.electrokinetic.co.uk

For more information on The Green Construction Board
visit www.greenconstructionboard.org
or email green.board@bis.gsi.gov.uk